

**Proposed Compensatory Mitigation Plan for  
Impacts to Waters of the U.S.  
Honolulu High-Capacity Transit Corridor Project**

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# ***Proposed Compensatory Mitigation Plan for Impacts to Waters of the U.S.***

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## **Introduction**

This document presents the proposed mitigation for identified impacts to waters of the U.S. associated with construction and operation of the Honolulu High-Capacity Transit Corridor Project (the Project). Included are the approaches used and results of a functional assessment of riparian and aquatic environments potentially impacted by the Project. A description of the affected environments is provided in the report *Wetlands and Waters of the U.S. Study, July 10, 2009, Honolulu High-Capacity Transit Corridor Project*. The locations and references made herein to numbered sites (1 through 31) come from that document. These sites are locations where plans for the linear transportation project indicate a potential interaction between project elements (mostly the guideway) and aquatic features (mostly streams crossed by the transit corridor).

The 31 sites surveyed in 2009 were grouped by categories based in part on the nature of the potential jurisdictional waters at the site, but principally on the nature of the impact of the Project on aquatic resources at each site. Five categories (I through V), ranging from lowest potential impact to greatest potential impact, are defined as follows:

**Category I** (4 sites) represent an absence of waters of the U.S. (and therefore no possible impact on aquatic resources and require no further consideration in this document)

**Categories II through IV** (18 sites) represent locations where waters of the U.S. are present but no structural elements of the Project are proposed for those waters

**Category V** (9 sites) represent locations where waters of the U.S. are present and structural elements actually or potentially encroach on those waters

Only the Category V sites require detailed consideration with regard to Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act. However, some secondary impacts (for example, runoff and shading) could occur at Category II, III, and IV sites.

## ***Summary of Avoidance for Stream Crossings***

The 31 survey sites represent 24 overcrossings of jurisdictional waters by the guideway. In the majority of these cases, the water body could be structurally avoided given the standard span (120 to 150 feet) between support columns and the narrow width of the streams to be crossed. The fact that many of the streams are confined to concrete channels further contributed to the ability of the engineers to design column locations outside of the Ordinary High Water Mark (OHWM). However, in a few cases, alternatives needed to be evaluated to minimize environmental impacts on jurisdictional waters where the width of the crossing exceeded the standard span or some other constraint

existed regarding placement of the support columns. For example, because of roadway intersections on both sides of Kapālama Canal at Dillingham Boulevard (Site 29), an original design of straddle bents was developed. This design proved unsatisfactory for a number of reasons, including costs and aesthetics. Widening Dillingham Boulevard is being planned as a separate project. By widening the bridge and creating a median, the lane configuration will match the widened roadway on both sides of the bridge, which will improve safety and enhance traffic flow. The median will then serve as a location for the support columns, providing a clear span of the guideway across Kapālama Canal. However, widening the existing bridge will entail extending existing bridge supports within the canal, thereby adding 12 small pilings in jurisdictional waters. The total area of these pilings has been added to the impacts total in this document.

Straddle bents are proposed for a number of locations where conditions will not permit a standard vertical support column (for example, roadways that cannot be moved). At Aolele Ditch (Site 25), straddle bents are proposed to cross the ditch in a location where the ditch and the guideway are nearly parallel to each other. The straddle bents avoid placement of at least two columns in potentially jurisdictional Aolele Ditch.

The width of the estuaries of both Moanalua (Site 27) and Nu‘uanu (Site 30) Streams will require spans in excess of 300 and 450 feet, respectively. A balanced cantilever span would be required, involving a different construction technique than that used for the majority of the other crossings for the Project. Placement of support columns in these waters cannot be reasonably avoided without greatly adding to the cost of the Project.

At site 11B, the stormwater outlet from Site 11A (the maintenance and storage facility) water quality basin was moved back from the shore to avoid construction in the tidal zone of Middle Loch. Finally, columns supporting the vehicle ramp, parking, and transit center structures over and adjacent to Waiawa Stream (Site 12) were redesigned to avoid the stream within the OHWM.

## ***Mitigation Goals and Objectives***

Regulations emphasize that mitigation is only to be considered after avoidance and minimization of impacts have been evaluated. The planning and engineering process of the Build Alternatives attempted to avoid or minimize impacts on aquatic resources, as discussed in Chapter 2 of the Final EIS for the Project (RTD 2010a) and in the 404(b)(1) analysis. This document examines the magnitude of the Project's effects that are anticipated after consideration of all alternative approaches (i.e., unavoidable impacts) and extends consideration of the nature of these impacts from strictly an amount (length, area, or volume) of fill to impacts on ecosystem functions and values at each affected site (Table 1). Further, this document contributes to the baseline information for both impact and proposed mitigation sites, describes and provides justification for the mitigation site, and serves as the Mitigation Plan in accordance with guidelines promulgated by the U.S. Army Corps of Engineers (USACE) (2005, 2008a, b).

**Table 1. Project Area/Volume of Fill and Linear Stream Impacts in Waters of the U.S.**

	Waiawa Stream	Waiawa Spring	Moanalua Stream	Kapālama Canal	Nu'uanu Stream	Total
<b>Construction Impacts</b>						
Total impact area (acres)	0.06	--	0.002	0.06	0.00	0.12
Total impact volume (CY) (below OHWM and above mudline)	300	--	11	511	35	857
Total impact volume (CY) (below mudline)	0	--	305	1,633	276	2,214
<b>Permanent Impacts</b>						
Total impact area (acres)	0.003	0.06	0.004	0.01	0.004	0.08
Total impact volume (CY) (below OHWM and above mudline)	10	185	8	61	27	291
Total impact volume (CY) (below mudline)	873	0.00	1,454	60	1,164	3,551
Linear feet of impact along stream	16	100	6	33	6	161

CY = cubic yards

OHWM = ordinary high water mark

The purpose of this document is to present the analyses of impacts to jurisdictional waters using a functions and values approach and present a plan for mitigation of those impacts to aquatic resources in the study corridor. As shown in Table 1, despite the large footprint of the Project, actual impacts to waters of the U.S. are minor: about 0.12 acre total (permanent impacts occur within the construction impacts area). However, it is the objective of this document to move away from a strictly 1-for-1 area compensation approach and consider functions and values of the impacted aquatic areas in establishing the proper level of compensatory mitigation. This draft version of the plan presents the general information on the proposed mitigation. If accepted by the USACE, plan details will be added for review and final acceptance.

## Functions and Values Assessment

### Background

Natural and “semi-natural” ecosystems provide a wide range of ecological and socio-economic goods and services (Odum & Odum 1972). Ecosystem functions are the physical, chemical, and biological attributes of a system without regard to their usefulness or importance to human society. Thus, interactions of biota and the physical world in a given location are necessary for an ecosystem to exist, although some of these functions result in various benefits to humans that can be valued. Thus, values are not the structure and functions that enable an ecosystem to exist, but a subset of these that benefit humans (de Groot, Wilson, and Boumans 2002). A good working definition for this subset is “the capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly” (de Groot 1992).

An assessment of ecosystem functions and values (Functional Assessment) has become a standard accompaniment to any activity that requires a State or Federal permit and that is anticipated to require some level of mitigation for unavoidable adverse impacts arising from the action. An Environmental Assessment (EA) or an Environmental Impact Statement (EIS) serves this purpose to some extent, but more formalized approaches have been steadily gaining acceptance since the late 1980s and are now emphasized in rule-making for Clean Water Act (CWA) actions (USACE 2008a). Indeed, wetland assessment procedures are now so numerous and varied that procedural approaches to selecting a wetland assessment method have become necessary (Bertoldus 1999a, 1999b, 2000). Stream mitigation approaches are less formalized and have had limited success (Bernhardt, et al., 2005, 2007). The functional assessment approach follows from the requirement that an ecosystem approach be used when determining compensatory mitigation requirements, replacing a strictly area-of-impact approach in most cases (USACE 2002). The mitigation objective becomes one of achieving no net loss of (wetland or aquatic) ecosystem functions and values rather than acreage or area *per se*. For streams, mitigation generally refers to the manipulation of the physical, chemical, and/or biological characteristics of a stream with the goal of repairing or replacing its natural functions (USACE 2008c).

Application for a Department of the Army Permit through the USACE under Section 404 of the CWA and/or Section 10 of the Rivers and Harbors Act requires a functional assessment (33 CFR §325.1 (d)(7) as amended) of rigor commensurate with the anticipated level of impact (USACE 2002, 2008a). Bertoldus (1999a) reviewed 40 different wetland assessment methods, many of which are applicable to aquatic environments other than wetlands. This document uses a functional assessment approach, although a methodology not specific for wetlands is needed because the Project only directly impacts stream and estuarine environments, with at most minimal shading imposed on a few wetland environments just outside the transit corridor.

Typically, functional assessment methods involve identifying functions and values specific to the aquatic environment impacted by the project, developing (or applying developed) metrics or metric scores representing a range of conditions for each function or value, and arriving at a total score or index value that represents a quantification of the resources. The score can then be used to assess before and after conditions of an activity or establish a level of mitigation commensurate with the impacts. This approach provides flexibility in establishing acceptable mitigation because it is unnecessary to replace each diminished function or value with an identical function or value enhanced to match.

## **Approach**

The Hydrogeomorphic Approach (HGM) used by the USACE recognizes three categories of function: hydrological function, physical process functions (e.g., biogeochemical functions), and biological functions related to habitat. The USACE-approved HGM approach requires development of assessment models that are calibrated based on reference sites. As a result, this approach is not useful in the present situation because the impacted sites are almost all stream and estuarine

environments in highly modified (man-made) channels. Models have not been developed for these environments in Hawai'i.

The approach used herein to evaluate compensatory mitigation requirements for the Project is as follows:

Each site where the linear transportation project is adjacent to or crosses a water of the U.S.<sup>1</sup> was visited and rated on a three-point scale for each of 22 function or value categories as modified (after de Groot, et al. 2002).

A Natural Resource Conservation Service (NRCS) (2001) visual assessment method developed for Hawai'i was completed for each stream site.

For stream sites where an actual impact is anticipated based upon design plans, the method and form developed by the Little Rock District of the USACE (USACE 2008c) for stream assessment was completed.

The "Little Rock District Method" cited above was deemed applicable in this assessment for two reasons: 1) impacts of the Project are relatively minor, calling for an uncomplicated and straightforward approach; and 2) methods developed for more typical streams in Hawai'i and elsewhere are not applicable to highly modified, estuarine reaches where impacts will occur from the Project. Many streams encountered in the Little Rock District (Mississippi Valley) are floodplain streams that have been modified (e.g., diked) for flood-control purposes, a characteristic common with the lowland stream and estuarine reaches of the urban stream segments crossed by the Project's structures. The NRCS method is a simplified or rapid approach to stream assessment used for many years on Hawaiian streams. Although a more detailed approach has since been developed (Kido 2008), this Index of Biotic Integrity method is not useful for estuaries because it compares sites with mountain reference streams.

Although regulations suggest (but do not require) mitigation within the same watershed, the impacts of the Project will occur in several small areas of different watersheds that would be difficult to mitigate separately while achieving a lasting effect. Impacted watersheds could be more broadly defined based on the nearby receiving water body for the estuary; these are Pearl Harbor, Ke'ehi Lagoon, and Honolulu Harbor. Of the three, Pearl Harbor has the greatest potential for benefit from a mitigation effort directed at improving functions within a contributing stream system because it is the largest estuarine environment (i.e., of a type closer to the environments impacted) and is the most enclosed; therefore it is the most sensitive to land impacts. The approach taken here is to consolidate mitigation at a single site (Site 12) on Waiawa Stream.

Waiawa Stream was selected over an estuary for mitigation because of the availability of land that is part of the Project where enhancement of the stream and potential establishment of a riverine wetland are possible with a high degree of success into perpetuity (i.e., the mitigation area would become part of the Project). Although the

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<sup>1</sup> TA preliminary jurisdictional determination approach is being followed for this Project. For the purposes of this document, all waters (including intermittent and ephemeral streams) are considered waters of the U. S. if they fit the definitions of tidal, wetland, RPW, or non-RPW waters. Sites 1 and 2 involve portions of Kalo'i Gulch, a modified drainage on the 'Ewa Plain with no natural outlet. The USACE has recently confirmed that it will not assert jurisdiction over Kalo'i Gulch and, therefore, these sites become Category I sites and are removed from consideration in this report.

Project will have minimal effect on the stream at Site 12, it will have a considerable effect on the riparian area at that location. Further, if the “spring” located there (Site 13) is jurisdictional, the impact area of constructing a culvert to direct spring flow from beneath the Pearl Highlands Station comprises about two-thirds of the linear stream impacts and three-quarters of the acreage of the permanent project impacts under USACE jurisdiction (Table 1).

Because Waiawa Stream at the site of the Project (Site 12) is a natural stream, a field survey of this area using more sophisticated stream assessment methods (such as the IBI approach; Kido 2008) would be justified to establish a preconstruction baseline against which the mitigation effort can later be monitored.

## **Results**

The first column of Table 2 lists various properties and functions of ecosystems (modified from de Groot, Wilson, and Boumans 2002). The functions are grouped into broad categories to facilitate understanding. These categories are as follows:

- Regulation functions
- Habitat functions
- Production functions
- Information functions

Regulation functions control essential ecological processes and life support systems, providing the benefits of clean air, clean water, and biological controls. Habitat functions are the provisions of habitat for wild plants and animals. This function contributes to biotic diversity. Production functions relate to the uptake of energy and nutrients to produce biomass. In many cases, such biomass can be harvested for direct human consumption or can contribute through the food chain to harvestable resources. Information values are varied but center around the concept that positive human experiences can be derived from access to the natural world and include spiritual, scientific, aesthetic, and recreational opportunities.

The typology presented by de Groot, Wilson, and Boumans (2002) is not included in its entirety but is pared down to relate easily to aquatic systems. Consideration is given to both the aquatic and non-aquatic component (e.g., riparian zone) in considering the functions represented by a location. Furthermore, in this assessment, this consideration does not concern itself with whether the function is compromised or directly/indirectly impacted by the Project. For each of the 21 locations (of the 31 sites originally inspected) along the study corridor where the route or proposed ancillary facilities, such as stations, parking, access roads, and maintenance facilities, are anticipated to impact a wetland or other jurisdictional aquatic features, a plus sign (+) is entered if the location provides some function or value. A negative sign (-) is used to indicate when conditions at the site are far less than ideal and may detract from a function or value. A zero (o) is used to indicate a neutral response (neither positive nor negative).



Table 2. List of Ecosystem Functions and Values Applied to Aquatic Sites Affected by the Project

	Site 4	Site 6	Site 7	Site 9	Site 10	Site 11B	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 22	Site 25	Site 27	Site 28	Site 29	Site 30	Site 31
	Hono'uli'uli Stream	Hō'ae'ae Stream	Waialeale Stream	Kapakahia Stream	Waipahu Canal	Middle Loch	Waiawa Stream	"Spring"	Pearl City Stream	Waiau Spring	Waimalu Stream	Kalauao Spring	Kalauao Stream	'Aiea Stream	Hālawā Stream	Aolele Ditch	Moanalua Stream	Kalihi Stream	Kapālama Canal	Nu'uānu Stream	Pa'ākauahi Gulch
Wetland Present	No	No	No	No	No	Yes	No	No	No	Yes	Yes	Yes	No	No	Yes	No	No	No	No	No	No
Jurisdictional Waters Present	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Project Effects Anticipated	<2>	<2>	<2>	<2>	<2>	<3>	<2,3>	<1,2,3>	<2>	<2>	<2>	<2>	<2>	none	<2>	<2,3>	<1,2,3>	<2>	<1,2,3>	<1,2,3>	<2>
Visual Assessment Score <sup>†</sup>	0.92	0.11	0.58	1.01	0.31	---	1.55	0.83	0.28	1.04	0.48	0.86	0.90	0.28	0.68	0.20	0.37	0.50	0.29	0.16	1.1
Regulation Functions																					
Climate regulation	+	-	o	o	-	+	+	o	-	+	o	+	o	o	+	+	+	+	+	+	+
Regulation of runoff and discharge	+	+	+	+	+	o	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Water supply—filtration, storage	+	-	o	+	-	o	+	+	-	+	o	+	o	-	o	o	o	o	o	o	+
Sediment/soil retention	+	-	-	+	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+
Soil formation	o	o	o	o	o	o	o	+	o	+	o	+	o	o	o	o	o	o	o	o	+
Nutrient regulation, storage, recycling	o	o	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	o
Waste treatment and recycling	o	o	o	o	o	o	o	o	o	+	o	+	o	o	o	+	o	o	o	o	o
Biological control—trophic dynamic	o	o	+	o	o	+	+	o	-	+	+	+	+	+	+	+	+	+	+	+	o
Habitat Functions																					
Refuge for aquatic fauna	o	-	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	-
Reproduction/nursery function	-	-	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	o
Feeding/foraging habitat	-	-	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	o
Production Functions and Values																					
Edible plants and animals	-	-	o	o	+	+	+	+	o	+	+	+	o	+	+	o	+	+	+	+	o
Renewable raw materials	-	-	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Genetic resources in wild biota	-	-	o	o	o	+	+	+	o	+	+	+	+	+	+	+	+	+	+	+	o
Medicinal resources	-	-	o	o	o	+	o	o	o	+	o	+	o	o	o	o	o	o	o	o	o
Ornamental resources	-	-	o	o	o	o	o	o	o	+	o	+	o	o	o	o	o	o	o	o	o
Information Values																					
Aesthetics	+	-	+	+	-	+	+	+	-	+	-	+	+	+	+	+	+	+	o	+	+
Recreation	o	-	o	o	+	+	+	+	-	+	+	-	o	+	+	o	+	+	+	+	o
Cultural value	o	o	o	o	o	o	o	o	o	+	o	o	o	o	o	o	o	o	o	o	o
Spiritual	+	o	-	o	-	+	+	o	o	+	o	o	o	o	o	o	o	o	o	o	o
Historical value	o	o	o	o	o	+	o	o	o	o	o	+	o	o	o	o	o	o	o	o	o
Science and educational value	o	o	o	+	+	+	+	+	o	+	+	+	+	+	+	+	+	+	+	+	+
Score	-1	-13	5	9	5	15	15	11	-7	20	10	17	10	11	13	12	13	13	12	13	6

Footnotes:

<sup>†</sup> From Stream Visual Assessment Report

Anticipated Effects:

- <1> Structural encroachment (fill): piling(s), culvert, etc.
- <2> Some degree of shading to jurisdictional waters
- <3> Direct stormwater runoff from guideway or other project structure

Table Scoring:

- Negative; function or value not enhanced, probably diminished by feature
- o Neutral; function or value not or minimally met by aquatic feature
- +

Any number of methods reviewed by Bertoldus (1999a) could serve as a source or starting point for a listing of functions and values pertinent to streams and wetlands. However, rather than tailor a listing from a method that was specific for a different purpose, a more thorough approach was obtained by starting with the very general typology of de Groot, et al. (2002) while considering the relevance of each of the ecosystem functions and values to the environments encountered by the Project. The category of “pollination” was removed from the list proposed by de Groot, et al., because it is not relevant in this situation; several other categories were combined (for example, “disturbance prevention (storms, floods)” into “regulation of runoff and discharge”; and “air purification” and “gas regulation” were combined into “climate regulation”). The category “refugium function” was split into two functions: “refuge for aquatic fauna” and “feeding/foraging habitat.”

Table 2 also summarizes scores from a Hawai‘i Stream Visual Assessment Protocol (HSVAP) undertaken at each stream crossing. This NRCS method was developed for Hawaiian streams (NRCS 2001) and uses 10 scored elements—including water clarity, plant growth, channel conditions, native species habitats, and riparian conditions—to arrive at a composite score. The Hawaiian version of this protocol is based upon a national model (NRCS 1998). A technical note accompanying the HSVAP describes the protocol as “provid[ing] a first step, basic level of stream quality evaluation, based primarily on physical conditions.”

Scores for the stream locations assessed range from 0.11 to 1.55. Considering that the majority of sites assessed are in modified channels in urban areas at existing bridge sites, the low scores are not unexpected. The highest score (Waiawa Stream, 1.55) represents a perennial freshwater flow in a natural stream channel. The HSVAP defines scores of 1.0 or less as indicating a Low rating; scores between 1.1 and 1.4 are Medium ratings; stream scores between 1.5 and 1.7 are rated High; and scores between 1.8 and 2.0 represent Very High ratings.

Table 2 summarizes the following anticipated effects of the Project on each aquatic environment:

- Structural (fill) elements of the project placed in waters of the U.S.
- Shading from the guideway as it crosses or passes over or next to an aquatic environment
- Runoff contributed from the guideway more or less directly into an aquatic environment

The structural encroachments will require a Department of the Army permit, and these direct impacts are considered further in this document as the basis of the mitigation requirements. Shading is included as an effect where the guideway or other structural elements will shade the aquatic environment to some extent. This effect is extremely variable throughout the day, in different seasons, and at each location. Because the guideway is elevated, the shading effect is spread out more than it would be for a low roadway bridge (i.e., a larger area experiences shading, but the shading tends to be more transitory). Shading reduces both water temperature and primary productivity. Both effects will be quite small from the narrow footprint of the Project at most locations and will have both positive and negative consequences.

Runoff effects are considered a potential impact only at locations where the structures proposed would capture and divert runoff into an aquatic environment in excess of the situation in the absence of the structure. Thus, because the guideway follows existing roadway corridors, no additional runoff will be generated since rainfall captured by the structure will have been captured by the roadway and, in most locations, this runoff will be directed into the existing street drainage system. The guideway in these cases does not increase runoff to adjacent aquatic environments. In the few case where this effect is indicated, the quality of the runoff will be treated by use of on-the-ground biofiltration structures or, where space does not provide for a biofiltration unit, a serviceable filter within the downspouts.

Table 3 provides the first part (scoring system) of the worksheet developed by the Little Rock District of the USACE. The table presents values for the metrics in Column 1 based upon the characteristics of the stream and the type of activity permitted. It has utility here in that the characteristics are simplified properties, functions, and values that can be easily applied to the impacts on jurisdictional waters assessed for the Project and the stream locations of each proposed fill. Table 4 demonstrates how the approach is applied for each fill location. For each impact site, the factors are generated based upon the category or range of conditions listed in Table 3. The results are summarized in Table 4. The following explanations are provided for each decision, modified from the full text given in USACE (2008c):

### **Stream Type**

Project impacts occur in perennial reaches of each stream.

### **Priority Area**

“Priority area is a factor used to determine the importance of the stream that would be impacted or used for mitigation” (USACE 2008c, p. 4). Based upon the examples given in the method, the majority of sites were ranked as secondary: 1) waters on the 303(d) list that are impaired by sediments or nutrients, and 2) stream or river reaches within high growth areas. Primary streams include at least one of the following:

- Waters with listed Federal endangered and threatened species
- National Wild and Scenic Rivers/Study Rivers
- Outstanding National Resource Waters
- Outstanding State Waters
- Extraordinary Resource Waterbodies
- Ecologically Sensitive Waters
- State Natural and Scenic Waters
- Approved greenway corridors

**Table 3. Adverse Impact Factors for Riverine Systems (ACOE 2008c)**

Metric	Factors								
Stream Type	Ephemeral 0.1			Intermittent 0.4			Perennial 0.8		
Priority Area	Tertiary 0.1			Secondary 0.4			Primary 0.8		
Existing Condition	Functionally Impaired 0.1			Moderately Functional 0.8			Fully Functional 1.6		
Duration	Temporary 0.1			Recurrent 0.1			Permanent 0.3		
Activity	Clearing 0.05	Bridge Footing 0.15	Below grade culvert 0.3	Armor 0.5	Detention 0.75	Morphological Change 1.5	Impoundment (dam) 2.0	Pipe >100 ft 2.2	Fill 2.5
Linear Impact	<100 ft 0	100 to 200 ft 0.05	201 to 500 ft 0.1	501 to 1000 ft 0.2	> 1000 linear feet (LF) 0.1 per 500 LF of impact (e.g., 5280 LF = 1.1)				

## Existing Conditions

Existing conditions represent the state of the physical, chemical, and biological health of a stream as compared with the least disturbed condition of similar streams in the region. With the exception of Waiawa Stream, all of the locations were assessed as functionally impaired: “[t]he stream is considered impaired if the reach has been channelized;” “[t]he stream has little or no riparian buffer with deep-rooted vegetation on one or both sides of the stream;” and “[t]he stream has five or greater stream impacts [culverts, pipes, or other man-made modifications] within 0.5 miles upstream...” (USACE 2008c, p. 6). Waiawa Stream was scored as moderately functional. To wit: “[t]he stream shows that human-induced sedimentation and erosion is moderate;” “[t]he stream has a moderate riparian buffer of deep-rooted vegetation present (minimum of at least 10 feet on both sides of the stream);” and “[t]he stream has no more than three stream impacts within 0.5 miles upstream of the proposed stream impact, including culverts, pipes, or other manmade modifications (with less than 100 feet of impacted section)” (USACE 2008c, p. 6).

## Duration

Duration is the amount of time adverse impacts are expected to last. In the case of operational impacts of the Project (as opposed to construction impacts), these will be permanent. Although construction impacts will have a larger area of impact, the duration will be less (factor = 0.1). These two types of impacts could be calculated separately.

## Activity

This metric is scored based on the structural impact type. All have been scored for bridge footings except Waiawa Stream (Site 12) and the nearby spring (Site 13). In the

latter case, the activity is essentially one of a pipe or open culvert, approximately 100 feet long. At Waiawa Stream, the main activity is clearing in the riparian area. While this activity is not permanent, the metric score is low, suggesting that was the intent in the protocol.

**Table 4. Calculations of “Mitigation Credits” for Impact Sites**

	Waiawa Stream	Waiawa “Spring”	Moanalua Stream	Kapālama Canal	Nu’uanu Stream
<b>Metric Scores</b>					
Stream Type	0.8	0.8	0.8	0.8	0.8
Priority Area	0.4	0.4	0.4	0.4	0.4
Existing Condition	0.8	0.1	0.1	0.1	0.1
Duration	0.3	0.3	0.3	0.3	0.3
Activity	0.05	0.3	0.15	0.15	0.15
Linear Impact	0	0.05	0	0	0
<b>Calculations</b>					
Sum of Factors (M)	2.4	1.9	1.8	1.8	1.8
Linear Feet of Stream Impacted in Reach (LF)	1800	100	6	33	6
Credit Deficit (M x LF)	4320	190	11	58	11

## Linear Impact

Linear impact is defined as the length of the stream, in feet, that would be impacted as authorized by the Department of the Army Permit for which mitigation will be required. The activities for most of the sites having permit requirements under Section 404 or Section 10 are less than 100 linear feet of stream (Table 1).

## Calculations

The Little Rock Method calculates a “Mitigation Credits Required” score as the grand total of the sum of factors times the linear feet of impacted stream (M x LF). This grand total is to be balanced by mitigation credits calculated by a similar process, thereby establishing the minimum mitigation required for a project. The mitigation credits required in this case could be 4,590. An interesting result, however, is how these credits break down by location. The placement of piers within the streams at four locations account for a requirement to mitigate 61 credits. The bulk of the credit requirement derives from removing vegetation along Waiawa Stream (Site 12).

## Scoring

The proposed mitigations for the Project are scored using separate worksheets (USACE 2008c). The following statement defines the purpose of this part of the calculations:

Compensatory stream mitigation involves the restoration, creation, enhancement, or — for streams of national or state significance because of the resources they support— preservation of streams and their associated floodplains. The purpose is to compensate

for unavoidable adverse impacts that remain after all appropriate and practicable avoidance and minimization have been achieved. Compensatory mitigation may be required for impacts to perennial, intermittent, and ephemeral streams and should be designed to restore, enhance, and maintain stream uses that are adversely impacted by authorized activities (USACE 2008a).

The type of mitigation (riparian buffer or stream channel creation, enhancement, restoration, or preservation) determines the applicable form. Details of the process are too lengthy, running to several pages, to include in their entirety here, so the instructions should be consulted for any deviations from what is presented in this report. The calculation of mitigation credits generated for a restoration of the riparian buffer at Site 12 on Waiawa Stream entails the following scoring (Table 5) and calculation (with reasoning following each score as provided in the instructions and work sheets):

Stream Type:	0.4	Perennial stream (Table 3)
Priority Area:	0.4	Secondary priority area (Table 3)
Net Benefit		
North Side:	0.0	Slope may be too steep to meet minimum width (= 0.2)
South Side:	0.8	Exotic removal and 51-100% replanted, >100 feet wide
Stream Protection Credit:	0.4	Restoration occurring on both sides of stream to extent possible; conservative average
Monitoring:	0.3	Level II <sup>2</sup> monitoring on both sides of stream
Control:	0.05	Restrictive covenant likely (no future development in riparian buffer)
Credits:	0	Mitigation action to be completed after impacts occur
Temporal Lag:	0	Buffer fully functional in five years or less

The sum of factors from above is 2.35; this value times the linear feet of stream buffer (each side not counted separately) of 1,800 feet yields 4,230 credits ( $C = M \times LF$ ) using a conservative estimate of the factor scores. Total credits generated would be this number times a Mitigation Factor of 1.0 for in-kind buffer replacement (= 4,230 total credits). Additional credits would need to be generated since there remains a deficit of 360 credits. This deficit can be erased by either achieving greater factor scores in the above calculation or undertaking another mitigation action.

<sup>2</sup> Level II monitoring from this source entails two of either: 1) photo reference sites, 2) plant survival counts, and 3) stream channel stability measurements. Also required are success/failure criteria and contingency plans in the event of failures. Inclusion of all three and biological monitoring as appropriate is Level III.

**Table 5. Riparian Buffer Creation, Enhancement, Restoration, and Preservation Metrics (USACE 2008c)**

Metric	Scoring Factors			
Stream Type	Ephemeral 0.05	Intermittent 0.2		Perennial 0.4
Priority Area	Tertiary 0.05	Secondary 0.2		Primary 0.4
Net Benefit	Livestock (from table)	Riparian creation, enhancement, restoration, and preservation (from ACOE 2009b, Table 1)		
System Protection Credit	Conditional: MBW restored or protected on both stream banks. To calculate: (Net Benefit Stream Side A + Net Benefit Stream Side B)/2			
Monitoring Contingency	Level I 0.05	Level II 0.15		Level III 0.25
Control	No Covenant/Restrictive Covenant 0.05		Conservation Easement/Deed Restrictions 1.5	
Credits (each side)	Schedule 1 0.15	Schedule 2 0.05		Schedule 3 0
Temporal Lag (years)	Over 20 -0.3	10 to 20 -0.2	5 to 10 -0.1	0 to 5 0

The sum of factors in the above calculation could be increased to 2.5 or greater to generate a total credit score of 5,440 or greater (well beyond the 4,590 credits required) by achieving higher credit scores. Possibilities are as follows:

Meeting the minimum buffer width on the north riparian buffer (it is not yet known if the minimum width can be met since this requires knowledge of the finished ground slope; potentially could add up to 0.6)

Addition of a conservation easement to the stream and buffer area (add 0.15) and/or Enhance monitoring to Level III (add 0.2); this alone would change the credit to 4,590, just balancing the mitigation requirement

Stream channel restoration or enhancement could also generate mitigation credits. For example, the process appears to allow a credit under Net Benefit for Stream Channel Preservation (no in-stream work/activity), although it is unclear if net benefit (>3,000 credits at the Waiawa Stream site) would be applied in conjunction with the proposed riparian enhancements or would require some stream channel restoration or enhancement activity as well. Even a modest additional effort, such as restoring stream bank stability or increasing the area of the floodplain, could generate credits in excess of 3,000 at the Waiawa Stream site.

Other mitigation credits could be gained by planting native trees and ground covers at other locations where a clear benefit could be achieved (such as at Sites 28 or 29). For example, planting of native vegetation in a 50-foot by 200-foot strip on both levees upstream and downstream of where the Project crosses Kāpalama Canal could be considered. Assuming that the west bank cannot meet the minimum buffer width but both sides are planted, total credits generated could be 430. This greatly exceeds the

credits required for all of the sites with fill in jurisdictional waters (61), although not an in-kind aquatic resource replacement, a fact considered by applying a Mitigation Factor of 0.5 instead of 1.0.

## **Mitigation Plan**

### ***Introduction***

The mitigation proposed herein follows the justifications expressed in the previous section. Specifically, it proposes that all or a majority of the mitigation required for project impacts on waters of the U.S. be undertaken at a single site: the property surrounding the Pearl Highlands Station. The following reasons are applied:

- The site represents a significant proportion of the total impact of the Project on O'ahu stream and riparian environments
- The site provides a significant parcel of land owned by the City and County of Honolulu (the project developer)
- The site incorporates a perennial stream in a natural bed amenable to improvements with a high likelihood of success
- The site offers opportunities for enhancement of a range of functions and values with respect to stream and riparian areas
- The mitigation is commensurate with solving other problems at this location, such as improving flood hydrology, treating runoff from the numerous project elements required for the property, and landscaping

The latter point is an important consideration: applying mitigation requirements as outlined in this document to project site needs both justifies a larger mitigation effort than would be the case given the Project's small amount of actual fill in waters of the U.S. and applies a more stringent ecological approach to achieving these other site requirements.

Details of the plan are presently being developed. However, this draft is being submitted for review by the USACE without details in order to elicit comments on the approach being proposed. If acceptable in concept, the plan will be expanded and resubmitted.

### ***Conceptual Design***

The mitigation proposed as a result of functions and values calculations and reasoning developed above is to restore the riparian areas on both banks of Waiawa Stream between the Kamehameha Highway Bridge (upstream) and the Farrington Highway Bridge (downstream) (see Mitigation Conceptual Design Plan Sheets at the end of this Proposed Compensatory Mitigation Plan). This section of the stream crosses an approximately 12-acre parcel (TMK 9-6-4:6; approximate parcel center at 21°23'50"N Lat. and 157°58'56"W Long.) owned by the City and County of Honolulu. The fixed guideway will cross the stream within this parcel of land, and the Pearl Highlands Station will be built on the parcel. This station is envisioned as an important nexus for transit users from the surrounding communities of Wahiawa and Pearl City, but more importantly from central O'ahu communities such as Waikele, Waiawa, and Mililani. In addition to the station platform structure, the site will support a bus transfer station, a



multi-story commuter park-and-ride structure, and access ramps from the H-2 Freeway and to and from the Kamehameha and Farrington Highways.

Because of past unregulated fill along the stream and the added structural elements, the property would require grading to restore hydrological capacity (Northwest Hydraulic Consultants 2009). Although the structures described would occupy approximately 30 percent of the 12-acre parcel, extensive grading of the land provides an opportunity to enhance the riparian zone, which is presently occupied by a mix of non-native trees, residences, and construction base yards. The crux of the proposed mitigation is to restore the riparian zone with native vegetation, creating a passive park (or landscape) to improve stream values, enhance the property as viewed from the transit guideway and structures, and preserve a portion of Waiawa Stream in a natural state. Although Waiawa Stream through this property flows in a natural bed, the opportunity exists to correct engineering-imposed problems resulting from the positioning of the two highway bridges that define the area. These structures are redirecting the stream flow and causing the stream to erode its banks, thereby contributing to poor water quality and eventual future problems to area roads (the worst erosion is occurring immediately adjacent to the Pearl Highlands Station location).

The large surface footprint of the roadways, parking and transit center, and guideway station create the potential for water quality impacts on Waiawa Stream from stormwater runoff that will need to be dealt with locally. Solutions include a water quality basin (stormwater detention basin) and/or treatment wetland. The latter could be included in the mitigation scheme if certain engineering problems related to capturing and redirecting runoff can be solved.

Finally, a small “spring” identified on the site and located under the project station will need to be addressed in an environmentally sound manner. The discharge is presently occurring at the point along Waiawa Stream where bank erosion is most severe. Whether the “spring” proves to be an actual permanent water source or only discharge from a local street drain, the present course to Waiawa Stream will need to be redesigned in a manner that extends the culvert. The redesign will correct the existing ponding situation and decrease stream bank erosion where the spring enters Waiawa Stream.

The mitigation proposed is, at least in part, *permittee-responsible mitigation through off-site and/or out-of-kind mitigation* (USCAE 2008a). The justification for this proposal is that the many small impacts from this linear transportation project are distributed in several different watersheds, are located in mostly estuarine waters in urban settings, and are within highly modified channels. These circumstances are difficult to mitigate directly either on-site or in-kind. Combining these impacts under the single, larger mitigation site at the Pearl Highlands Station parcel and along Waiawa Stream best fulfills the requirements for compensatory mitigation.

The mitigation proposed herein is essentially to integrate—in an ecologically sound manner while employing visually pleasing landscaping principles—the riparian zone restoration with various engineered solutions needed to solve problems that occur wherever manmade structures and an active stream intersect. In the past, these problems were solved primarily by forcing a stream into a concrete-lined channel. In this

case, all demands on the floodway imposed by the Project should be satisfied by the restoration of the floodway (by removal of historic fill as necessary) and minimization of artificial materials within the stream and creation of a riparian zone dominated by native plants.

### ***Timing of Mitigation Actions***

Site work on the Pearl Highlands Station is presently scheduled for mid-2010. The first construction activity will be restoration of hydrological function (removal of unauthorized fill and site grading). This will expose the site to erosion above the banks and will require application of various best management practices (BMPs) to reduce potentially adverse erosion. It is anticipated that water quality monitoring in the stream as required by Water Quality Certification (Hawai'i Department of Health (HDOH)) will have included completion of baseline sampling. A stream biological survey will also have been completed, as well as a survey of plants in the zone along the stream not included in grading (see section on Monitoring, below).

Planting of the riparian zone will begin as soon as practicable after grading, but may be initially limited to areas away from construction sites for safety reasons and to avoid losses due to construction activities. The purpose of early initial planting in areas where feasible is to reduce erosion on land and deal with weedy vegetation that would otherwise return and dominate these areas.

### ***Detailed Plan***

An early concern will be to minimize erosion following grading and until plantings are established. Use of silt-curtains should help, but geotextile fabric coverings will need to be installed in most areas where native plantings are made since hydro-mulch cannot be used unless the seeds are from native grasses. Some success has been achieved with native ground covers (grasses, vines, herbs) as initial colonizers on bare surfaces to hold the soil until shrubs, and later, trees become established, gradually converting open lands to a forest in a natural progression (plant succession).

Plans presently divide the site into mitigation and landscaping areas (see Figure 1), requiring coordination in terms of the plants selected for each area. The mitigation goal of establishing a riparian forest of indigenous plants could be compromised if the plants put into landscape areas are invasive. The landscaping team is well aware of this problem and is avoiding use of invasive species.

## **Monitoring**

### ***Ecological Performance Standards***

The proposed mitigation involves enhancements to the riparian zone and perhaps changes to the stream itself. Since the goal of this mitigation is to preserve and enhance stream and riparian environments, performance standards will be developed for stream water quality, aquatic organisms in the stream, and plantings in the riparian zone. Based on ecological theory, these aspects should be closely interrelated, although the

nature of the relationships is not understood in all cases. One problem is the limited segment of the stream/riparian zone being modified. For example, can strictly local (site) improvement in water quality positively influence stream biota subjected to influences from everywhere else in the watershed? There is ample evidence that close attention to maintaining a natural riparian zone has positive impacts on stream habitat and therefore stream biological resources. Less clear is the relationship between different species and the quality of stream habitats. Evidence suggests that native forests are more beneficial to stream ecology favoring native macrofauna than non-native. However, these studies compare intact plant communities through which streams flow. Planting a riparian zone along a stream is landscaping, no matter the make-up of the plantings selected. In time, it is hoped that using native species will benefit stream ecology, but selecting only native species is basically a cultural exercise, one that emphasizes basic values unique to Hawai'i. In the long-term, the appreciation of the users of the Pearl Highlands Station for the landscape created along Waiawa Stream may be as important as the environmental benefits achieved. Emphasis on native plantings in all areas of the landscaping at this site could serve as a theme for this transit nexus.

Performance standards for stream macrobiota will also involve consideration of native vs. non-native aquatic fauna. Kido (2008) argues that the native species of stream macrofauna present is an indicator of stream ecosystem health. The native Hawaiian freshwater fish fauna consists of one indigenous (*Awaous guamensis* or *o'opu nakea*) and three endemic (*Lentipes concolor* or *o'opu alamo'o*, *Sicyopterus stimpsoni* or *o'opu nopili*, and *Stenogobius hawaiiensis* or *o'opu naniha*) gobies, and one endemic eleotrid (*Eleotris sandwicensis* or *o'opu akupa*; Kinzie 1990). These species are typically distributed along a relatively well-established continuum of species ranges from the headwaters of a stream to the ocean. Thus, not all are anticipated to occur at the mitigation site. In addition, the native macrofauna includes several species of invertebrates.

Water quality measurements encompassing the state water quality standards for streams (HDOH 2004) allow for characterization of the stream system in the mitigation segment in terms of conditions deemed acceptable to support stream life.

### ***Stream Biological Monitoring***

Stream monitoring will begin with a detailed baseline survey using methods developed by Kido (2008) for rating the ecosystem health of Hawaiian streams. This approach uses the IBI developed through a field survey to assess stream ecological conditions in comparison with pristine streams in the Hawaiian Islands. The IBI and stream habitat surveys will be repeated at yearly intervals over a minimum of five years after completion of restoration and enhancement activities. The purpose of this monitoring will be to detect any improvement or decline in stream health as measured by indices currently in use in Hawai'i.

Because the stream segment at the Project is only a fraction of the total Waiawa Stream system, success of the mitigation proposed may or may not be dependent upon the mitigation efforts taken, but any sign of decline in aquatic resources will require more in

depth study to rule out influences from the site. If the latter can be determined to be responsible or contributing, recommendations for correcting the adverse factors will be generated and implemented. Biological monitoring will be adaptive in the sense that both fixed and movable sampling stations will be used to provide both a stable monitoring point(s) for direct year-to-year comparisons and to ensure that all resources in the segment are identified each year.

### ***Stream Water Quality Monitoring***

Monitoring of stream water quality through the segment can be anticipated as a requirement to be imposed by HDOH as part of the Project's Water Quality Certification under CWA Section 401. This Water Quality Certification monitoring program will be tied to the construction phase, with a short post-construction monitoring element. However, stream quality monitoring will be continued for the duration of stream biota monitoring as a means of ensuring good water quality for the biological community. This monitoring will be set up to identify probable sources of pollutants so that any attributable to project operations can be dealt with and corrected.

### ***Riparian Vegetation Monitoring***

Regular quantitative monitoring of plants in the riparian zone will be conducted to demonstrate establishment of a largely native assemblage. Given the paucity of native plant species presently in the area, success criteria based upon percentage of native plants would be unwise. Maintaining a high success rate of plantings over several years will require a trained and dedicated crew to tend to desirable species and remove undesirable species. In the end, the larger plants (trees and shrubs) will dominate the riparian zone, and natives will prevail if properly selected and, as needed, aided through the sensitive juvenile stage. Allowing for counting of species considered early aboriginal introductions (so-called "canoe plants"), it is expected that 90 percent or better of the tree canopy, 60 percent or better of the shrub layer, and 30 to 40 percent of the herbaceous plants will be native (Polynesian introductions plus indigenous/endemic species) at the end of 10 years.

As the monitoring progresses, success of the initial plantings will be of primary concern. Should failures occur, plants will be replaced. However, consideration will be given in all such cases to replacement with a different native species that may be more suitable. Landscape planting to a natural setting with native plants is an expanding art and science in Hawai'i, so success can be achieved. However, there are numerous unknowns, and every such effort is to some degree experimental. Intact lowland ecosystems dominated by natives and appropriate for this area no longer exist on O'ahu, but commercial sources of plants and expertise on native plantings are both available.

# Long-Term Considerations

## ***Maintenance Plan***

Over the long term, the site should be largely self-maintaining. At some point, achieving and maintaining functions and values of the riparian zone may outweigh native composition in importance, but a strong initial effort should allow both goals to be achieved. The City and County of Honolulu Rapid Transit Division will be expected to maintain the landscaping in perpetuity as passive parkland, preserving riparian functionality.

## ***Site Protection and Financial Assurances***

The 12-acre parcel being used to develop the Pearl Highlands Station and accompanying roadways and transit center structures is owned by the project developer, the City and County of Honolulu. The Mitigation Plan will be adopted by the City and County of Honolulu and included in the budget for the Project. This may require a two-phase budgeting process: an initial development and implementation budget included within the fixed-guideway cost accounting and a long-term adaptive management, maintenance, and monitoring budget within the operational budget structure.

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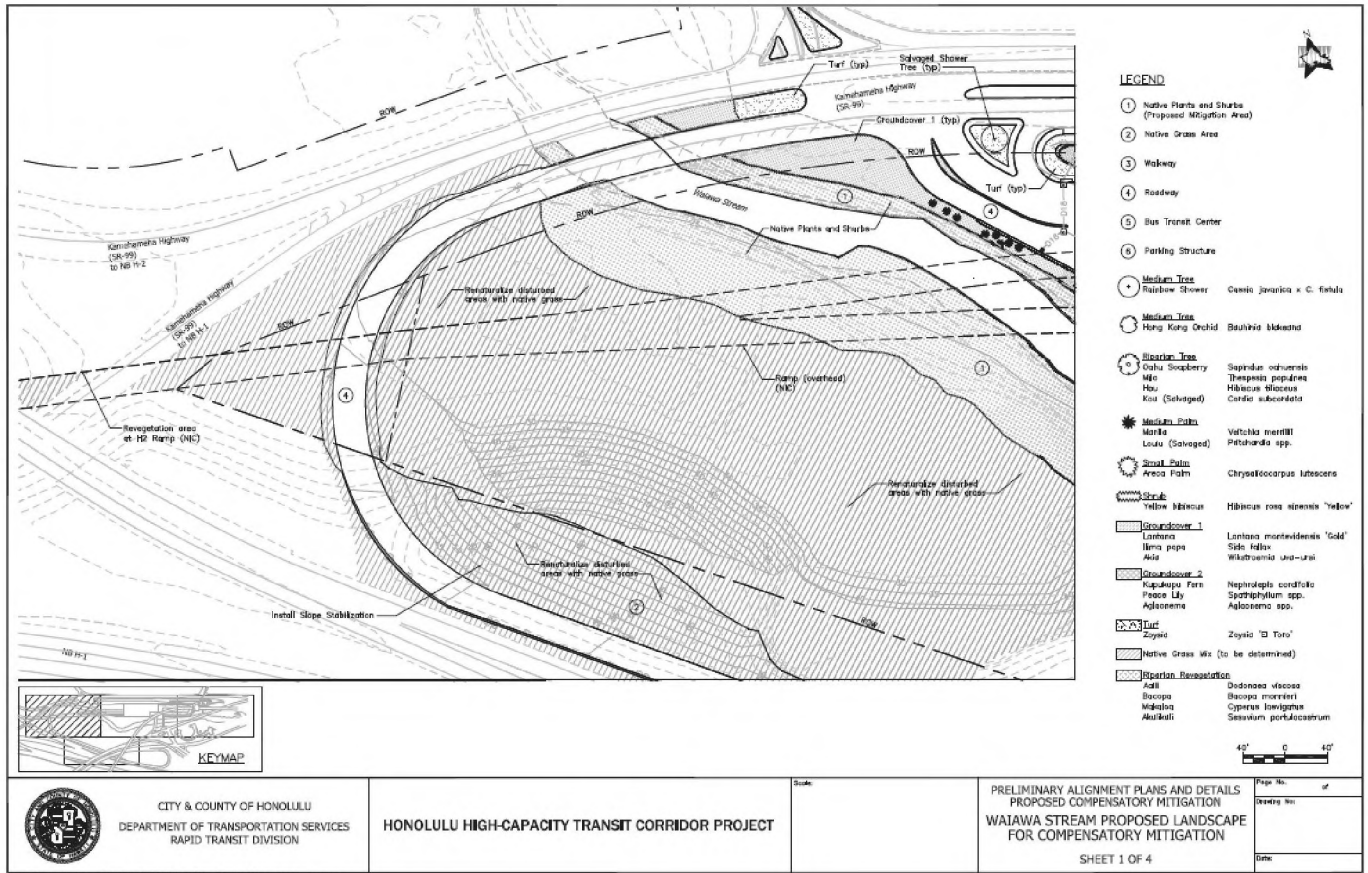
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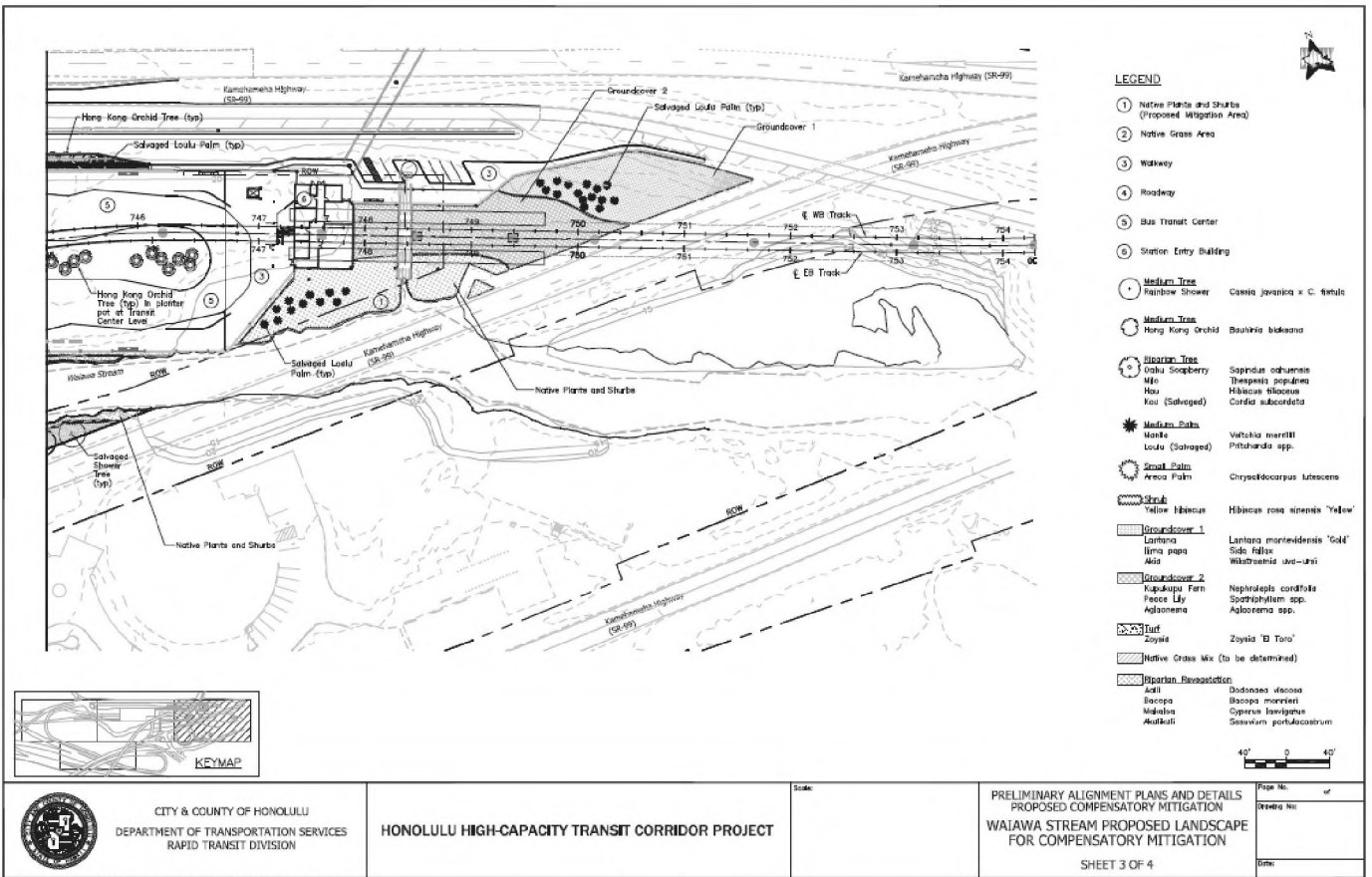
## Mitigation Conceptual Design Plan Sheets

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